SOLVING ELECTROMAGNETIC WAVE PROPAGATION PROBLEMS USING FENICS

Steven Vandekerckhove[a], Herbert De Gersem[a], Garth N. Wells[b]

[a] *KU Leuven Kulak - Etienne Sabbelaan 53, 8500 Kortrijk, Belgium*
[b] *University of Cambridge - Department of Engineering - Trumpington Street, Cambridge CB2 1PZ, United Kingdom*

The FEniCS Project [1] is a collaborative project for the development of innovative concepts and tools for automated scientific computing, with a particular focus on the automated solution of differential equations by finite element methods. The open source project started in 2003 and has reached sufficient maturity to be used in new and full scale applications. The project does not only support classical Lagrange finite elements, but also a.o. discontinuous and Whitney elements. Many features and aspect of PDE simulations are continuously being improved to suit the needs of the users. The main appeal of this software is the high level interfaces reconciled with performance in parallelisation. These allow fast implementation of finite element solvers for many PDEs due to the large library of supported elements.

The FEniCS software can easily be used to solve the Maxwell wave equation, which will be illustrated. With the help of the dolfin-adjoint library [2], also backward problems, such as inverse electromagnetic scattering, can be solved using this software.

References:

[1] A. Logg, K.-A. Mardal, G. N. Wells, *Automated Solution of Differential Equations by the Finite Element Method*, Lecture Notes in Computational Science and Engineering , 84, Springer Berlin Heidelberg, 2012.

[2] P. E. Farrell, D. A. Ham, S. W. Funke and M. E. Rognes, *Automated derivation of the adjoint of high-level transient finite element programs*, arXiv:1204.5577, 2012.